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Improving The Silage Quality of Napier Grass (Penissetum Pupureum) Using Probiotic Local Microorganism (MOL) Banana Stem (Musa Paradisiaca)

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ABSTRACT

Objective: *This study aims to determine the improvement of the quality of napier grass silage (pennisetum purpureum) by using Probiotic Local Miroorganism (MOL) banana stems on moisture content, ash content, protein, fat and crude fiber.* ***Method:*** *This research was conducted at the Faculty of Agriculture Laboratory, Abulyatama University, Aceh Besar Regency. This study used a completely randomised design (CRD) one-way pattern with 4 treatments and 4 replications. The treatments consisted of P0 (Napier grass without mole (control)), P1 (Napier grass treated with mole with a concentration of 1 ml), P2 (Napier grass treated with mole with a concentration of 2 ml) and P3 (Napier grass treated with mole with a concentration of 3 ml).* ***Results:*** *The results showed that the addition of 2 ml MOL in napier grass silage could reduce the water content to 67.08%, while the protein content increased to 12.43% with the addition of 3 ml MOL. The addition of probiotics in napier grass silage had a very significant effect (P<0.01) on crude fiber, protein and moisture content. While the addition of MOL in silage had no significant effect (P>0.05) on fat content and ash content.* ***Novelty:*** *This research demonstrates an innovation in improving the quality of elephant grass silage by utilizing local probiotic microorganisms (ML) from banana stems, a previously unused approach. The novelty lies in the use of MOL from banana stems as a silage fermentation additive, which has been shown to significantly increase protein content and reduce moisture content, as well as positively impact crude fiber.*

INTRODUCTION

Elephant grass (*Pennisetum purpureum)* is a superior type of grass that has high productivity and nutritional content and has high palatability for ruminant livestock. This plant is a type of high-quality forage and is favored by livestock. This grass can grow in various land conditions, is resistant to shade, responsive to fertilization, and can survive in both high and low soil fertility levels [1]. Elephant grass can be given fresh, as silage, or as hay, and its nutritional value can be enhanced through a fermentation process using probiotics such as Local Microorganisms (ML). The use of MML can increase protein content, reduce crude fiber levels, and improve the aroma and taste of feed ingredients, making them more palatable to livestock.

Local Microorganisms (OL) are liquid cultures produced from the fermentation of local organic materials containing beneficial microbes such as lactic acid bacteria, yeast, and actinomycetes. OOL functions as an active biological agent (bioactivator) or decomposer that helps accelerate the fermentation process in feed ingredients, organic fertilizers, and other organic materials. The addition of OOL during the fermentation process can increase the activity of beneficial microorganisms while suppressing the growth of harmful microbes. Fermentation itself is a biochemical process in which organic compounds are converted through the activity of enzymes produced by microorganisms [2]. Furthermore, OOL is economical and environmentally friendly because it can be made by farmers themselves from local ingredients.

So far, silage production generally uses commercial probiotics such as EM4 which are easily available on the market. However, the use of MOL made naturally from local materials, such as banana stems (*Musa paradisiaca)*, has not been widely optimized by farmers as a probiotic alternative. In fact, banana stems have potential as raw materials for MOL due to their high sugar and water content, which supports the growth of fermentative microorganisms. Therefore, this study was conducted as an initial step to test the use of MOL from banana stems in the process of making elephant grass silage. The focus of this study was to determine the effect of adding banana stem MOL on the nutrient content of silage, such as water content, ash content, crude fiber content, fat content, and crude protein from elephant grass.

Based on research results [3], elephant grass contains 22.20% dry matter, 8.69% crude protein, 2.71% fat, 32.30% crude fiber, 12.00% ash, 41.82% BETN, 0.48% calcium, and 0.35% phosphorus. Although its nutritional content is already relatively high, processing elephant grass through a fermentation process such as silage with the addition of MOL probiotics is expected to further increase its nutritional value, improve shelf life, and make it more efficient as an alternative feed outside the rainy season.

Banana stems contain potential nutrients, such as water, crude fiber, and several minerals, which can be used as animal feed ingredients. However, the high content of crude fiber, including lignin and cellulose, is a major obstacle in its direct use [4]. Previous research conducted by [5]added 5% molasses in banana stem silage could not affect the crude fat and BETN content. The use of banana stem molasses in elephant grass silage needs to be further studied, whether its use affects the quality of silage such as; water content, crude fiber, crude protein, crude fat and ash and at what dosage does the use affect the quality of silage? The results of this study are expected to provide real benefits for farmers to improve the quality of silage by utilizing banana stem molasses which is easy to obtain, process and produce.

RESEARCH METHOD

This research was conducted at the Laboratory of the Faculty of Agriculture, Abulyatama University, Aceh Besar Regency. The equipment used in this study were: knives, plastic wrap, digital scales, measuring cups, electric stoves, spatulas, ovens, filter paper, beakers, and furnaces. The materials used consisted of elephant grass, molasses, probiotics, minerals, and salt.

This research is a laboratory and field research using a one-way Completely Randomized Design (CRD) with 4 treatments and 4 replications, namely:
P0 = No Probiotics + 700gr RG + 150gr bran + 50 ml molasses + 100 ml water

P1 = 1 ml probiotic + 700gr RG + 150gr bran + 49 ml molasses + 100 ml water
P2 = 2 ml probiotics + 700gr RG + 150 gr bran + 48 ml molasses +100 ml water
P3 = 3 ml probiotics + 700gr RG + 150 gr bran + 47 ml molasses + 100 ml water
Each treatment was repeated 4 times.

Table 1. Amount of ingredients used.

Treatment	Ingredients used (gr/ml)				
	Mol	Elephant Grass	Bran	Molas	Water
P0	0	700	150	50	100
P1	1	700	150	49	100
P2	2	700	150	48	100
P3	3	700	150	47	100

Sample Population, Sample Size and Sampling Techniques

1. Research Population

The population in this study was elephant grass that had been fermented using probiotics and without using probiotics with a total of 16 samples and each sample was given a treatment and replication code. The selection of data sources in this study was not based on emotional closeness, partners, and other things that could affect the objectivity of data acquisition, but rather the data obtained was purely because it was in accordance with the interests of the problem and the objectives of the research Azmi & Yusuf.

2. Research Sample

The samples in this study were 16 fermented elephant grass samples, namely P0, P1, P2, and P3. Each sample was analyzed for its proximate content, which consisted of water content, dry matter content, protein content, and ash content.

3. Research Parameters

The parameters measured in this study were: water content, dry matter content, protein content and ash content in each of the treatments P0, P1, P2 and P3.

4. Crude Protein Measurement

Weigh 2 grams of sample and place it in a test tube, then add 1 gram of selenium, 2.5 ml of H_2SO_4, and 3 drops of H2O2. Then carry out the dilution, distillation, and titration stages. Then, calculate the protein content using the formula:

Protein Content % = % N x conversion factor (6.25) [6].

5. Water content measurement

Measurement of water content by drying (thermogravimetry) The principle of determining moisture content by drying is the evaporation of water from the material by heating. The material is then weighed until a constant weight is reached, indicating that all the water contained in the material has evaporated.

The method for determining water content by drying according to [6]is: A 3-5 g sample is weighed and placed into a dried, known-weight dish. The sample and dish are then dried in an oven at 105 ^{0}C for 6 hours. The dish is cooled and weighed, then dried again until a constant weight is achieved.

Water content can be calculated using the following formula:

Information :

W = sample weight before drying (gr)

W1 = weight of sample and dry cup (gr)

W2 = weight of empty cup (gr)

6. Dry matter content meter

The method used in laboratory analysis for dry matter is the *Weende method.* Twenty samples were taken for laboratory testing. The steps for determining dry matter content are as follows:

a. Vochdoos weighed closed (X grams)
b. The sample was weighed ± 2 grams (Y grams), then placed in a drying oven at a temperature of 105 ^{0}C for 8 hours with the lid removed.
c. Cool in a desiccator for one hour with the lid removed. After cooling, close it again and weigh it (Z grams).
d. The calculation of dry ingredients is:

$$\text{Water Content (\%)} = \frac{X + Y - Z}{Y} \times 100\%$$

Y Dry Matter (%) = 100 - Water Content

7. Ash content measurement

Content is known, are then ashed in a furnace at a temperature of 650 °C for 12 hours. The ash content of the dry media was calculated based on the equation [7]:

$$\text{Ash content } = \frac{berat\ abu}{berat\ kering} \text{x } 100\%$$

Research Procedures

The preparation of banana stem MOL begins with preparing 2 kg of chopped and mashed banana stems, 400 g of fine brown sugar, and 4 L of rice washing water. These three ingredients are put into a bucket and stirred until evenly mixed. After the stirring process is complete, the bucket is tightly closed. The top of the bucket is provided with a hole to channel the hose inside the bucket and the bottle containing water. The fermentation process of banana stem MOL is carried out for 14 days, producing a spirit/alcohol-like aroma and a brownish/blackish color.

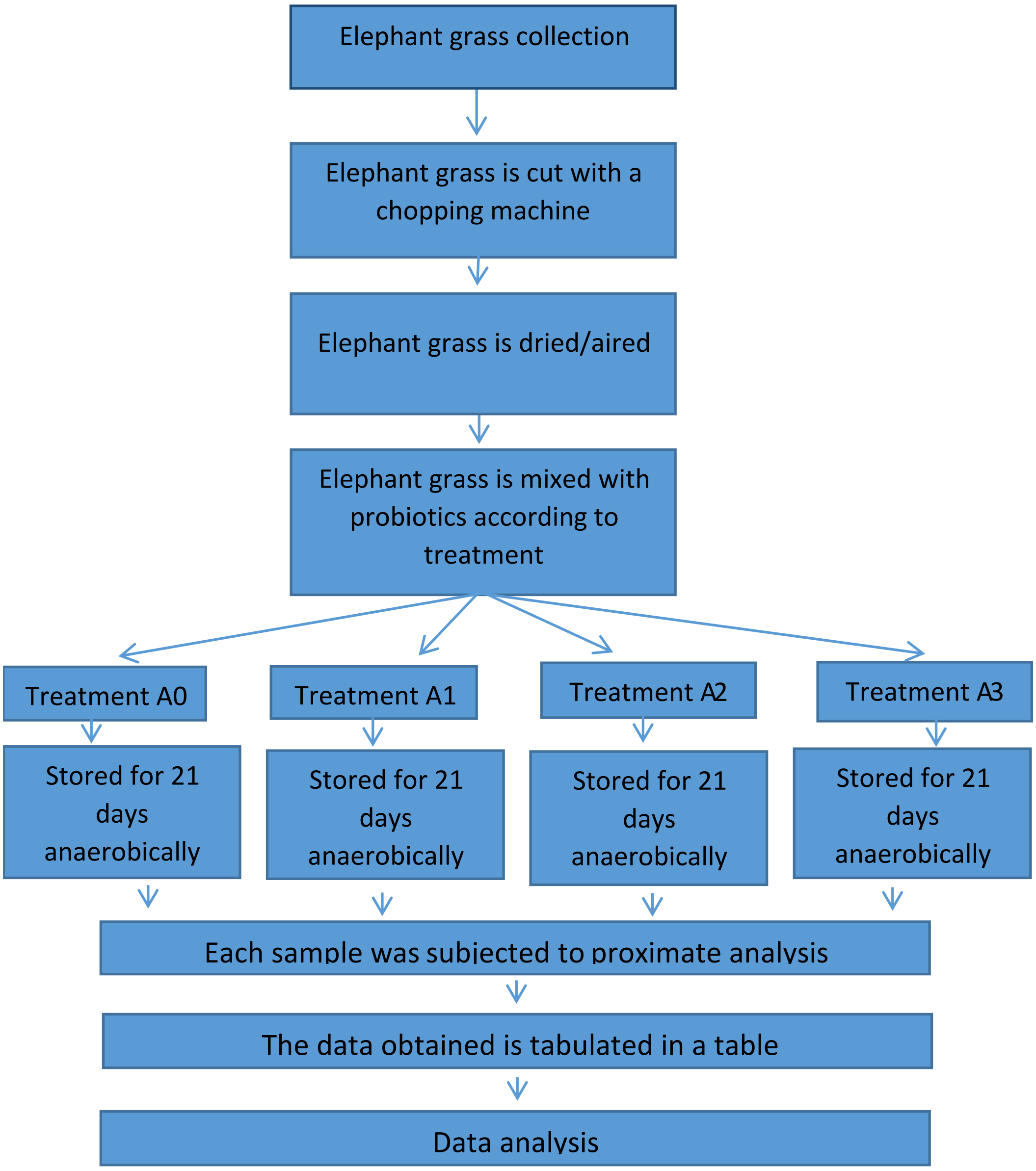

Figure 3. Research procedures.

Data Analysis

This study used a completely randomized design with a one-way pattern with 4 treatments and 4 replications, namely P_{0}, P_{1}, P_{2} and P_{3} (0 ml; 1ml ; 2 ml, and 3ml), each treatment was repeated 4 times. The quality data of protein percentage, water content and ash content obtained were analyzed using ANOVA analysis of variance, and if there were differences, then a further test of the Least Significant Difference (LSD) was carried out (*Steel and Torrie,* 1990).

RESULTS AND DISCUSSION

Water Content of Elephant Grass Silage (*Penisseturm pupureum)* with the Addition of Local Microorganisms (MOL) from Banana Stems

Based on the results of laboratory analysis of the percentage of water content of elephant grass (Penissetum pupureum) with different percentages of probiotic use, it is shown in table 2 below:

Table 2. Percentage of water content of elephant grass silage (Penissetum pupureum).

Treatment	Water Content Percentage (%)
P0	72.85 ± 0.51 [d]
P1	68.72 ± 0.01 [c]
P2	67.08 ± 0.03 [a]
P3	67.85 ± 0.01 [b]

Note: The results of the analysis of variance showed a very significant effect between the treatments (P<0.01).

The percentage of water content in the table above shows from P0, P1, P2, P3, namely: P0 (72.85%), P1 (68.72%), P2 (67.08%), P3 (67.85%). Based on the results of the analysis of variance on the percentage of water content of elephant grass silage (Penissetum pupureum) with the use of different levels of probiotics, it shows a very significant difference (P <0.01). The results of the analysis of table 4.1 above show that there is a very significant effect on the addition of MOL in elephant grass silage (Penissetum pupureum), on the percentage of water content. The different water content of the material before and after the silage making process is caused by the respiration process which can reduce the water content of the material or the formation of metabolic water during the fermentation process which can increase the water content of the silage. Therefore, the water content of the silage material can be higher than after it becomes silage, but conversely, the water content can also be lower [8].

Based on the measurement of water content above, the percentage of dry matter content of P0, P1, P2, P3 is obtained, namely: P0 (27.15%), P1 (31.28%), P2 (32.92%), P3 (32.15%). Dry weight production can be used as a benchmark for how much green fodder will be given to livestock. The higher the dry weight, the less feed will be given to livestock.

The percentage of different additions of Local Microorganism Probiotics (MOL) in elephant grass silage gave a very significant effect (P<0.01) between treatments. The percentage of water content in the treatment (P0) without probiotics showed an average water content of 72.85%, compared to P1, P2, and P3 with the addition of probiotics of (1 ml, 2 ml and 3 ml) P0 had a higher percentage of water content, this shows that the addition of Local Microorganism Probiotics (MOL) has a role in improving feed quality, in accordance with the statement [9] which states that the higher the water content of a feed ingredient, the lower the percentage of nutrient content of the feed ingredient.

Water content is the percentage of water content of a material that can be expressed based on wet weight or dry weight. Water content based on wet weight is the ratio between the weight of water in a material and the total weight of the material, while water content based on dry weight is the ratio between the weight of water in a material and the dry weight of the material [10]. Feed raw materials that contain high water content will cause the feed material to be easily damaged because it is easy to grow mold or rot so that the nutritional content of the feed material will decrease.

According to [11] During the fermentation process of silage production, microorganisms are active in converting glucose into alcohol, organic acids, H2O, and CO2. High glucose fermentation activity by microorganisms will result in a high water content, resulting in a higher moisture content in the silage.

Protein Content of Elephant Grass Silage (Penisseturm Pupureum) with the Addition of Local Microorganisms (MOL)

The results of the analysis of the protein content of elephant grass silage (Penissetum pupureum) with the addition of different probiotic doses are shown in table 3 below.

Table 3. Protein content of elephant grass silage.

Treatment	Protein Content Percentage (%)
P0	7.55 ±0.48 [a]
P1	9.28 ±0.09 [b]
P2	10.30 ±0.07 [c]
P3	12.43 ±0.09 [d]

Caption: Results of a variance analysis shows a very influential effect significant (P<0.01).

Based on the results of the analysis of variance on the percentage of protein content of elephant grass silage (Penissetum pupureum), it shows that the addition of probiotics with different doses from 1 ml to 3 ml in the production of elephant grass silage has a very significant effect. significant (P<0.01) on protein levels, meaning that Ho is rejected and Hi is accepted. Based on the proximate analysis, it shows that the highest protein value is found in the P3 treatment, which is 12.43 %. While the lowest protein value is found in the P0 treatment, with a protein value of 7.55 %.

According to [12] Elephant grass contains 6.26% crude protein, which is 9.66% crude protein [13]. According to [14]the difference in nutrient content in elephant grass, especially for crude protein, is that the older the plant, the lower the protein content. The low level of old protein can be caused by the older the plant, the higher the percentage of stems compared to leaves. The crude protein content of elephant grass silage is greatly influenced by the time of defoliation, the older the age of defoliation, the lower the protein content and conversely the crude fiber content will increase with increasing age of defoliation. The increase in crude protein content occurs due to the bioconversion of sugar into mycelial protein or single cell protein [15]. [16]stated that the secretion of extracellular enzymes from the inoculum also plays a role in increasing the protein content of the fermentation substrate biomass, the more mycelium due to fungal growth, the more nitrogen the body contains and this is a protein contribution to the fermented substrate.

Ash Content of Elephant Grass Silage (Penisseturm pupureum) with the Addition of Local Microorganisms (MOL) from Banana Stems

Based on the results of laboratory analysis of the percentage of elephant grass ash content with different percentages of probiotic use, it is shown in Table 4 below:

Table 4. Percentage of ash content of elephant grass silage (Penissetum pupureum).

Treatment	Ash content percentage (%)
P0	3.48 ± 0.48 [a]
P1	3.63 ± 0.55 [b]
P2	3.79 ± 0.26 [c]
P3	3.90 ± 0.11 [d]

Note: The results of the analysis of variance showed no significant effect (P>0.05).

The results of the analysis of variance on the percentage of ash content of elephant grass silage with different amounts of probiotics showed no significant effect (P>0.05). This means that Ho is accepted and Hi is rejected, so the addition of local microorganism probiotics (MOL) in elephant grass silage did not show a very significant effect on the ash content. This condition is caused by the fact that in each treatment no minerals were added so that it did not affect the ash content in each treatment.

The longer the fermentation, the ash content will increase because the fermentation process will increase the content of organic acids such as acetic acid, malic acid, oxalic acid, and others. If the content of organic acids increases, the salt content in these organic acids will also increase, thus causing an increase in the ash content in the feed. Minerals contained in a material consist of two types of salts, namely organic salts (salts from malic acid, oxalic acid, acetic acid, and others) and inorganic salts (phosphate, carbonate, chloride, sulfate nitrate, and alkali metals) [17].

Fat Content of Elephant Grass Silage (Penisseturm pupureum) with the Addition of Local Microorganisms (MOL) from Banana Stems

Based on the results of laboratory analysis of the percentage of fat content of elephant grass silage with different percentages of probiotic use, it is shown in Table 5 below:

Table 5. Percentage of fat content of elephant grass silage (Penissetum pupureum).

Treatment	Fat Percentage (%)
P0	2.05 ± 0.05 [a]
P1	2.26 ± 0.05 [b]
P2	2.35 ± 0.04 [c]
P3	2.44 ± 0.04 [d]

Note: The results of the analysis of variance showed no significant effect (P>0.05).

Based on the results of the analysis of variance on the percentage of fat content, it showed no significant effect (P>0.05). This means that Ho is accepted and Hi is rejected, so the addition of local microorganism probiotics (MOL) in elephant grass silage did not show a significant effect on fat content. This condition is caused by the fact that in each treatment no minerals were added so it did not affect the fat content in each treatment.

Based on the results of the analysis, it shows that the addition of probiotics (MOL) in the production of elephant grass silage (*Penissetum pupureum*) with the use of different doses of 1 ml to 3 ml has no effect on the fat content of the silage.

This means that the higher the dose of probiotics added in silage making cannot increase the fat content of elephant grass silage (*Penissetum pupureum*). According to Amrullah, the crude fat content of feed ingredients consists of glycerol esters, fatty acids and fat-soluble vitamins that are easily evaporated.

Fat is essential in the diet, serving as a source of essential fatty acids and energy. Because of its high energy content, fat can add energy to food without increasing its volume too much, Tillman.

Crude Fiber Content of Elephant Grass Silage (*Penisseturm pupureum)* with the Addition of Local Microorganisms (MOL) from Banana Stems

Based on the results of laboratory analysis of the percentage of crude fiber content of elephant grass silage with different percentages of probiotic use, it is shown in Table 6 below:

Table 6. Percentage of crude fiber content of elephant grass silage (Penissetum pupureum).

Treatment	Crude Fiber Percentage (%)
P0	11.74 ± 0.06 d
P1	11.5 ± 0.13 c
P2	10.23 ± 0.05 b
P3	9.93 ± 0.17 a

Note: The results of the analysis of variance showed a significant effect (P>0.01).

The results of the analysis of variance on the percentage of crude fiber content of elephant grass silage (*Penissetum pupureum*) showed that the addition of probiotics with different doses from 0 ml to 3 ml in the production of elephant grass silage (*Penissetum pupureum*) showed a very significant effect. significant (P<0.01) on protein content, meaning rejecting Ho and accepting Hi. Based on the proximate analysis, it shows that the highest fiber content value was found in treatment P0, namely 11.74 %. While the lowest crude fiber value was found in treatment P3, with a crude fiber value of 9.93 %.

Crude fiber consists of insoluble polysaccharides (cellulose and hemicellulose) and lignin. Crude fiber cannot be digested by nonruminants, but it is a source of energy for rumen microbes and stomach filler for ruminants [18]. Crude fiber is very important in fulfilling the nutritional needs of livestock, Anggorodi. Crude fiber can be utilized well by ruminants due to the ability of bacteria or microbes present in the rumen.

Carbohydrates are only divided into two types: crude fiber and N-free extract (BETN), where crude fiber contains cellulose, several hemicelluloses, and other polysaccharides that function as plant protection materials, Tillman.

CONCLUSION

Fundamental Finding : The addition of 2 ml of local microorganism probiotics (MOL) in elephant grass silage can reduce the water content to 67.08% and increase the protein content, with the increase in the addition of local microorganism probiotics (MOL) compared to other treatments, namely 12.43%. The addition of 1 ml of local microorganism probiotics (MOL) can increase the crude fiber content compared to the control and other treatments. The addition of local microorganism probiotics (MOL) has no effect on the treatment of ash and fat. **Implication :** These findings indicate that the application of local microorganism probiotics (MOL), especially in specific concentrations, plays a significant role in modifying the nutritional profile of elephant grass silage. By optimizing moisture and protein levels, MOL offers a practical solution for improving feed quality, which could support more efficient livestock nutrition strategies. **Limitation :** However, the study found that the addition of local microorganism probiotics (MOL) has no effect on the treatment of ash and fat, suggesting that its influence may be limited to specific nutritional components and not comprehensive across all parameters of silage quality. **Future Research :** Further research is needed on the use of probiotics in making elephant grass silage to determine the percentage of ash and fat content and the need for additional doses above 3 ml of probiotic use in making elephant grass silage to increase the protein content of elephant grass silage.

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